A COMMENT ON ACCESS TO DIGITAL DATA FOR FOOD SUPPLY CHAIN DECISION MAKING & COMPETITIVENESS IN AUSTRALIA

Elizabeth Jackson[1] and Simon Cook[2]

[1] School of Management, Curtin University, Western Australia

[2] Premier's Fellow, Curtin University and Murdoch University, Western Australia

Introduction

This paper discusses the changing structural nature of food supply chains in Australia and the impact this has had on the availability of high-quality data for decision making in an environment of unpredictable change. We stress the importance of reliable and accessible data to support agribusiness sustainability in the changes agri-food supply chains are undergoing from production, processing and consumer perspectives. Data are credited as being "the new oil" (van t'Spijker, 2014) and the key driver of the fourth industrial revolution (Schwab, 2017). They are necessary to support change in response to the demands of a constantly evolving global market.

Like much of the post-World War II Western world, Australia enjoyed government support in the form of agricultural policy development to structure its food supply chains to ensure food production was seamless and protected from disruptive competition. While Australians were not incentivised onto the land via generous government subsidies, as was the case in Europe and North America, government support for agri-food production, distribution and marketing was provided in the forms of statutory transport, warehousing and marketing authorities. These created fully-integrated, low-cost commodity supply chains that not only provided Australian citizens with reliable quantities of safe, nutritious food but great surpluses were exported to our colonial masters and nearby neighbours. We also enjoyed excellent government-funded data collection initiatives that monitored production, imports and exports. A series of policy failures, such as the government's wool reserve price scheme, eventuated in the industry-wide deregulation of most agricultural sectors. While the advent of free markets and competition has had the desired effect on stream-lining agricultural supply chains and minimising waste, the privatisation of many sectors and the rationalisation of government services has resulted in high-quality, reliable industry data being transformed from being a readily-available public good to a private good. In the absence of government support, high-quality data are now mostly generated by wealthy agribusinesses with the intellectual and financial capital to recognise their value.

Literature review

Australia has long-enjoyed a highly efficient supply chain for its bulk agricultural commodities; particularly in the grains sector. Up until the past 10-15 years, statutory regulations ensured exclusive logistics, storage, handling, marketing and outloading (i.e. exporting ports) rights to particular organisations. For example, the situation in Western Australia was that Westrail had exclusive rights to transport grain from country elevators to ports, Co-operative Bulk Handling had exclusive rights to store and handle grain up-country and at ports, the Australian Wheat Board had exclusive marketing rights over wheat production, the Grain Pool of WA had exclusive marketing rights over other bulk commodity grains (e.g. barley, oats, canola, lupins, etc.) and the state's four port authorities had exclusive rights to export bulk grain to overseas customers for value adding. The Wheat Marketing Act of 2008 marked a watershed moment in the structure of Australia's protected supply chain sectors. After 70 years of protection, this new act removed power from the Australian Wheat Board thereby creating competition in the market for accumulation and selling of Australian grains. The situation now is that anyone can buy and market Australian grain into the global market (Heard, 2018). The deregulation of other grain supply chain sectors followed; as did deregulation of the wool industry.

Increased competition, among other factors, has imposed a prolonged cost squeeze on the Australian grain supply chain but White, Carter and Kingwell (2018) found that Australia's supply chain costs remain higher than most of its competitors' costs resulting in high market grain prices. Competitors around the Black Sea and Argentina are low-cost grain suppliers and are investing in technology and infrastructure to make costs even lower. As such Australia must follow-suit and ensure its supply chain costs are low so it remains competitive in the international grain market. This is particularly important for Western Australia as 95% of its grain is produced for the export market (White, Carter & Kingwell, 2018). In their investigation of Australia's grain supply chain, White, Carter and Kingwell (2018) concluded that better business transparency is required to improve the current situation. This is directly linked to the provision of safe, reliable data that can be used for business performance reporting and the building of trust between key players; particularly when it comes to reducing costs.

Australia's bulk commodity supply chain has changed because of agri-political directives. Outside Australia, changes are occurring as a result of the invisible hand that guides market behaviours and these changes are influencing quantities of data being collected. Mooney (2017) suggests that mergers between already sizable global agribusinesses is creating a small yet powerful concentration of companies that put food production at risk. Mooney (2017, p. 13) cites "the $130 billion merger between US agro-chemical giants Dow and DuPont, Bayer's $66 billion buyout of Monsanto, ChemChina's acquisition of Syngenta for $44 billion and its planned merger with Sinochem in 2018" as examples of increased concentration in global agribusiness. The research covered major farm inputs (seed, agrochemicals, genetics, pharmaceuticals and machinery), service providers (commodity traders) and downstream players (food processors and retailers). From this, eight impacts of concentration where identified; one of these impacts relates to the control of information. It is suggested that big data, generated from big agribusinesses, is one of the main drivers of concentration and the possession of big data sets could limit smaller firms from entering markets. A further issue to emerge, also considered by Bronson and Knezevic (2016), is the quantity of data that are being generated from the value-adding brand extension services that agribusiness firms are implementing. Cases in point include yield monitors fitted in modern combine harvesters and Monsanto Corporation's Weed I.D. "app" for identifying weeds in-paddock. While such data collection devices provide information for farmers, the question that arises surrounds data ownership. Does the farmer own the data or is it owned by the technology provider? If ownership lies with the technology provider then big data sets about farm production and productivity are being collected at alarmingly fast rates and being held within private enterprise. Further questions arise about the decisions that are being made and strategies that are being developed from these data. Is unlicensed third-party data being used for the improvement of big agribusiness?

This argument provides insight into data generation from traditional farms that are characterised as micro-businesses operating in an environment of perfect competition however farms have changed in nature since the 1960s when the first "corporate farms" emerged in the USA. These types of farms, also known as "mega farms", are characterised as being larger than 500,000 hectares and, as Plunkett et al. (2017) suggest, require scale to compete with the lower overhead costs of smaller, traditional farms. Scale of production is not limited to land mass. Mega farms are also livestock production units with Smithfield Foods Inc. in the USA cited as producing around 18 million pigs per annum (Hermans et al., 2017) and Penhros Farms is one of the UK's 800 mega farms and has the capacity to produce over a million birds per annum (Wasley and Davies, 2017). Animal welfare and retail quality standards demand that vast quantities of data are collected in the production of these animals. Data on growth rates, weights, nutrition, feed consumption, feed conversion, fluid consumption, pharmaceuticals consumption, housing temperature, production costs, among others, are kept in abundance for traceability, quality assurance and risk management purposes. The amount of data collection required, combined with the quantity of livestock being produced means that, once again, data sources are increasing at unprecedented rates. At this point, it must be noted that the mega farms described herein are holding these data and in no way are they supported by government interventions.

The vertical integration of farming systems (where a single entity owns and operates through a supply chain of farm, logistics, processing, distribution, etc), is another phenomenon facilitating the generation of mass quantities of data. An example of this is the ASX-listed AACo; an Australian beef producer which farms, feedlots and processes from nearly 430,000 cattle over 7 million hectares (AACo, 2019). Research by Carillo, Caracciolo and Cembalo (2016) suggests that vertical integration increases supply chain competitiveness so it is likely that this farming model will become more popular as improvements in competitiveness and profits are realised. As with other mega farms, vertically integrated agribusinesses will be generating significant quantities of data without government intervention.

Government intervention has been mentioned herein several times. This is to highlight the independence of farming systems from the type of government support that was discussed at the beginning of this paper. In the Australian context, both the grain and wool industries have had government regulation removed in the past 15 years. The result is that the relationship between government and farmers is decoupling. While this separation has not hindered productivity, the responsibility of governments to collect data and support agri-food supply chain decision making has certainly diminished. Herein lies the problem.

The problem

The nature of Australia's agri-food supply chain governance and infrastructure appears to have shifted power and scale so dominance now lies with siloed private enterprise whereas, in years gone by, the power lay with cross-sector governments; data that was in the public domain are now appropriated in the private domain. Grain and livestock sectors in Australia are particular cases in point here. Productivity is not the problem, in fact productivity in these sectors has increased despite the challenges of diminishing rural populations, increasing input costs and climate change (Boult and Chancellor, 2019). The problem is public accessibility to data.

Discussion

The advent of precision agriculture in the 1990s resulted in the widely-researched implementation of technology-supported farming. The research was conducted in expectation of change but by and large, precision agriculture has failed to deliver. It was expected to enable better management of field operations to achieve greater efficiencies of input or operations, or to yield product of higher quality. As described by Lamb et al. (2008), a lot of the research failed to translate fully from an academic to an operational reality because the technology providers failed to link to users. There were also some important lessons about the true nature of change; this was overlooked because specialists focussed on technological details, instead of the process it enabled (Cook et al., 1998).

Blackburn, Freeland and Gärtner (2017) reports on McKinsey's Australian Industry Digitisation Index, a measure of digital penetration across sectors and the gap between the digital frontier and the rest of the economy. The index shows that agriculture rates as the lowest of all industries considered in understanding digitisation. The news is not all bad, though. Of the 14 factors rated as very low to low digitisation, digital supply chains where ranked as medium digitisation. So, there is some hope of improved performance. Conversely, probably as a result of the nature of change in agriculture, much of the technology in agriculture is embedded within machinery, agrochemicals and genetic material, all of which are protected by private enterprise; so the scope for disruption is limited.

So far in this paper, several points have been argued: 1) there has been a shift away from government power to private enterprise power in Australian agri-food systems thereby isolating data to the private sector, 2) the world is experiencing a rise in the scale and output of individual agri-food suppliers (i.e. the concentration of agribusinesses and the advent of mega farms), 3) expectations of quality have increased in global agri-food supply chains (particularly in livestock systems) so more data are being collected than ever before, 4) efforts have been made in the past to improve agri-food technology but

have experienced limited success due to an emphasis on the technology rather than its enabling features, 5) agriculture is the poorest-performing sector in McKinsey's Australian Industry Digitisation Index and 6) Australian grain supply chains need to improve in their competitiveness.

It is suggested that, while there is a rise in the quantity of data being generated, Australia may be behind in the use of data and digitalisation because the data that *are* being generated are not accessible to those who make recommendations for competitiveness in the global market for food. We question if the keepers of this data are aware of the asset that they are holding? Private enterprise that is aware of the cost and value of the data that it owns keep it close to their metaphorical chests as good-quality data are an inimitable source of competitive advantage. Private enterprise that is unaware of the cost and value of its data risks wasting resources as the collection and storage of data is an overhead cost, rather than an asset that generates value for the business. Whatever the case, the theoretical research that needs to be conducted across sectors to improve supply chain competitiveness and sustainability is being thwarted by the inaccessible nature of data. Australia exports enough food to feed more than 61.5 million people (Keogh, 2014) so there is a substantial reliance on the safety and security of its global food supply. Data sources are available for this type of work but they are unlinked and inaccessible to people who take a systems view of the agri-food supply chain.

It is therefore proposed that an inverse relationship exists between government power in the agriculture sector for generating data as a public good and the private sector locking vast quantities of data for its isolated decision making. It is acknowledged that the total quantity of data is increasing. But, while the total quantity of data is increasing, the relative fraction of common intellectual property available for analysis is unidentified so application decreases. The result of which is illustrated in Figure 1.

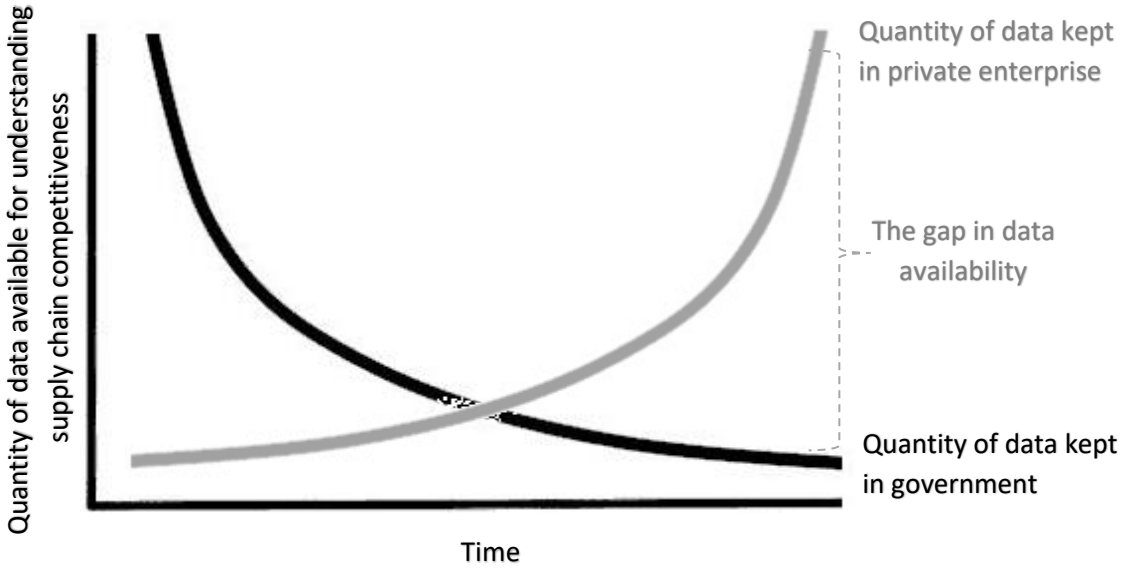

Figure 1: The proposed inverse relationship of data available for understanding agri-food competitiveness

Vertically integrated agribusinesses have gone someway to addressing the problem of unintegrated data systems but several problems still remain. We need to understand how to change the availability of unappropriated data and also encourage the entrepreneurship necessary to develop business models that create and share value from data. We may be able to seek understanding from the knowledge-based view of the firm proposed by Grant (1996) who suggested that organisations are units of knowledge generation and application which facilitates competitive advantage. This was in

contrast to previous thinking that organisations are pools of resources that can achieve competitive advantage if those resources are organised better and more efficiently than other industry players. This is known as the resource-based view of the firm (Barney, 1991). Little research has been conducted on the knowledge or resource views of agribusiness firms. We therefore suggest that there may be an under-appreciation of data for supply chain decision making within the sector. There is no doubt that agribusinesses value data, but making it accessible to external parties to promote supply chain competitiveness remains a mystery.

It is well known that trust is an important factor in successful supply chain collaborations; agribusiness supply chains are no exception (Fritz and Fischer, 2007). Similarly, as supply chains become increasingly long and complex, they become inherently riskier in which to operate (Christopher and Peck, 2004). A genuine risk of making private data accessible as a public good is the threat of cyber security breach. Governments have an important role to play in helping to reduce the risk of sharing supply chain data and encouraging trust by supporting reasonable protection and sharing of data. An example of this is the European Union's General Data Protection Regulation which came into effect in May, 2018. This regulation was designed to harmonise the data protection rules of European states but, most importantly, it is a pan-European strategy for instilling trust in online services. Australia has a position on this Regulation but it largely remains aligned with its Privacy Act of 1988.

Despite all the current knowledge on data sharing and collaborative supply chains, there remains a struggle to inspire big agribusiness to share their data for addressing cross-sectoral questions. An example of a cross-sectoral question that has failed to be addressed and is becoming increasingly important to understand is resilience of Australia's major export commodities. The agricultural sector is vulnerable to numerous biotic and abiotic risks. Hence the sector needs robust, resilient systems to manage its vulnerabilities appropriately and efficiently. Estimating resilience has been discussed in many fora (e.g. humanitarian aid, natural disaster management, psychology, ecology, epidemiology and sociology) but a system-wide approach based on digital data to understand and benchmark resilience is lacking, especially in the agricultural sector. The Western Australian economy is heavily reliant on food production, manufacturing and associated services (food retail sales value was $13.8 billion in 2015/16). Furthermore, Australia exports enough food to feed more than 61.5 million people (Keogh, 2014) so there is a substantial reliance on the safety and security of Australia's global food supply. While considerable advances have been made to digitise the agricultural sector, these advances are yet to incorporate resilience measures for informing decision makers and helping them respond to major stresses. Cases in point include The CBH Group's trial of blockchain to improve productivity, DPIRD's Agrifood and Fisheries Export Services Portal that provides market information for export business development, the MLA's National Livestock Identification System for identification and traceability of cattle, sheep and goats to promote competitive advantage through biosecurity and food safety. In terms of Western Australia's ability to meet global food demands in an environment that is vulnerable to uncertain, random climate conditions, current knowledge encompasses issues on wheat yields and quality. Nuttall et al. (2017) found that climate change will negatively impact wheat quality by decreasing protein concentration which translates into reduced functional properties. Hughes, Lawson and Valle (2017) suggest that climate conditions have lowered total factor productivity in Western Australia by an average of 7.7% between 2000–01 and 2014–15. They also present evidence to suggest that, despite this, farmers are using technologies and management practices to adapt to these changes. Similarly, Huai (2017) found Western Australian wheat production to be "sensitive" in terms of biophysical resilience to drought in 2006-2010 but other constructs of the study (on-site adaptive capacity, off-site adaptive capacity, adaptive capacity and synthesised resilience) achieved his definition of "resilience". Huai's (2017) study is significant as it has developed a framework for measuring both climate and social resilience.

Against this background of efforts to digitise the agricultural sector and build supply chains that will provide safe and secure food to meet global demands, a data-driven, system-wide model was

proposed to the agri-food sector that would use existing digital business intelligence data to 1) develop resilience benchmarks of the Western Australian grain value chain and 2) provide digital feedback and strategic intelligence on resilience to value chain members. The project failed due to lack of accessible data and the "closed" nature of its businesses.

Conclusion

The purpose of this paper was to discuss the conundrum agri-food supply chain enthusiasts face when attempting to address cross-sectoral problems that require data to join-up individual members of fragmented chains; the type that dominate Australian agri-food supply chains. It is suggested that the decoupling of food production from being the responsibility of the government to the responsibility of private enterprise is one of the barriers to having problems properly addressed, principally because data are no longer in the public domain as they were in years gone by. It has also been suggested that the growth of farm business (in scale and supply chain dominance) and consumer demand for safe, nutritious food has facilitated the growth in quantity of data about agri-food enterprises. The role of data to create value is increasingly being recognised as essential for enabling business innovation and has created a paradigm shift in the way businesses compete (van t'Spijker, 2014). Furthermore, technology and data are at the heart of what Schwab (2017) describes as the latest industrial revolution. Australian agriculture is behind (Blackburn, Freeland and Gärtner, 2017), but is catching up fast.

Our argument increases in complexity because as the volume of data increases, appropriation is uneven. If data are appropriated by enterprises within closed business models, the ability of organisations around those enterprises to adjust is compromised, hence the adaptation of the entire supply chain. Agribusinesses operate in a systems environment. As they are faced with increased unpredictable change from climate variability and erratic consumer preferences, there is an increasing reliance on service organisations for support e.g. banks, insurance providers, consultancies, research institutions etc. In order to make good, cross-sectoral decisions, robust data must be accessible throughout the agri-food supply chain.

The position of these closed models within the value chain is important. With agri-food supply chains becoming increasingly dominated by mega farms and vertically integrated enterprises (Mooney, 2017), opportunities for change may be limited as these enterprises view themselves as too big to fail. This contrasts markedly with the picture of digital disruption portrayed as indicative of open systems that are driving the Fourth Industrial Revolution.

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